ELECTRICAL REVIEW

[ILLUSTRATED.]

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(Formerly Review of Telegraph and Telephone.)

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Electric Time.

A NEW FIELD OF ELECTRICAL WORK—THE TELEGRAPHIC TIME COMPANY TO THE FRONT.

There has been organized in this city the corporation known as The Telegraphic Time Company, with general offices in Temple Court, Nos. 5 and 7 Beekman Street. At its head are business men of means and ability, who realized the importance of reliable time to every one, and have been for months past perfecting the details of their business, until they are at the present time the owners of a large number of valuable patents, covering all departments of the system, both electrical and mechanical, and are prepared to furnish the public, at a very small cost indeed, with an unvarying, accurate system of time. They have a large factory building in Brooklyn, near the end of the great bridge, and a conspicuous sign, reading "The Telegraphic Time Company," is daily read by the many thousands passing over the bridge between the two cities. There is probably not another spot in this wide world where a sign could be seen by more people in a day, and the Time Company have been wide-awake enough to see this fact. In the service of the company are a number of capable and experienced experts, and the company is well organized and equipped for furnishing the public with accurate and satisfactory time. The complete success of the company's system has been demonstrated by the most thorough and exhaustive practical tests, and it is now in operation in an important section of the city of New York, also Boston, Providence, New Bedford, Taunton, Brockton, Lowell, Lynn, Salem, Worcester, Newburyport, Lawrence, Portland, Chicago, Pittsburgh and Cincinnati. In these cities a few months' work by companies operating under licenses from the Telegraphic Time Company, has shown the popular demand for electric time to be very pronounced. In the city of Boston, the Boston Electric Time Company has in operation about 1,000 clocks, giving perfect satisfaction. In the State of Massachusetts, outside of Boston, over 800 electric clocks are in use, the territory being operated by the Massachusetts Electric Time Company. The Electric Time Company of Providence have already in operation about 900 clocks. The demand is increasing in all these places, and other companies are being licensed as rapidly as organized.

The system consists of a prime electric regulator clock which is maintained exactly correct by comparison with observatory impulses, and which synchronizes by means of electricity a number of precisely similar regulators, each of which furnishes time to the subscribers in its district. This district consists of a single city block, or even one large building containing a number of offices, such as are now so common in New York and other large cities, or a hotel, factory, apartment-house, or residence. Neither housetop nor pole lines are required in this system, the wires being attached to the sides and walls of buildings principally within courtyards, skylights, well-holes, and they never cross streets. The method for securing the general introduction of the company's time service is attended with no objectionable features, and will avoid all interference with public and private rights. As the largest district which one regulator controls consists of one city block only, the liability of the lines to interruption is reduced to a minimum.

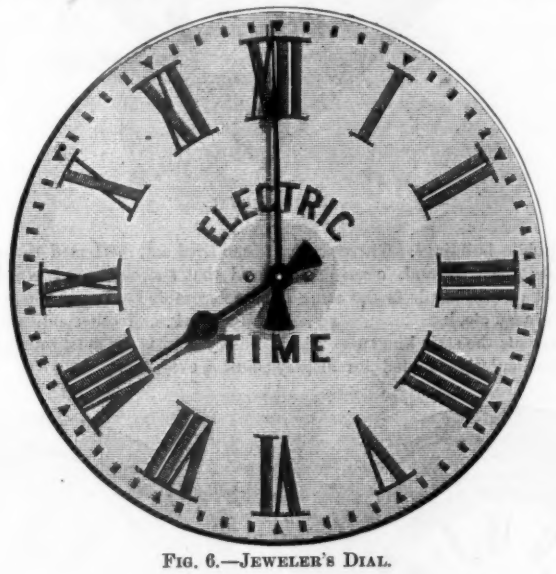


FIG. 6.—JEWELER'S DIAL.

This company, with the best inventive and constructive talent attainable, and with excellent facilities, has expended a large amount of money in perfecting electric clocks and electric time systems, resulting in the development of by far the best electric clocks and controlling devices ever produced. They are simple and reliable in their operation, and exhibit a high degree of ingenuity. The electric regulators, purely electrical in their action, are so constructed that any variation in strength of the electric current, due to changes in temperature or other causes, in no way affects their time rate. The secondary clocks or dials receive their impulses from the regulator with absolute uniformity; their construction is simple, and as their action is purely automatic, no winding or attention of any kind is necessary.

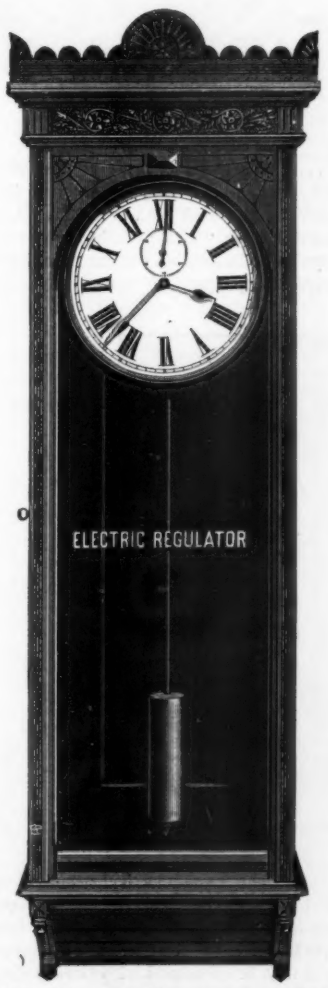


FIG. 1.—ELECTRIC REGULATOR OF TELEGRAPHIC TIME CO.

FIG. 2.—ELECTRO-MECHANICAL REGULATOR, SHOWING MOTOR.

As an outgrowth of the above, has been the evolution of the electro-mechanical clocks. These constitute the great success which will meet the necessities already enumerated for exact time. While for purposes of distinction called the electro-mechanical clock, it might well be termed purely electrical, since it receives none but electrical energy, and the storage of the same automatically, to meet the requirements of the clock mechanism. These clocks, possessing the highest refinements as timekeepers, and running independently for one to two years without being touched in any way, are synchronized or controlled by the main system, so that all within the same district or town are giving time correctly to the second, and uniformly with the standard.

In case of any accident to the wire of the controlling system these clocks do not stop. Their rate is so close that in the interval between the breakage and repair of the wire none could have varied but a small fraction of a second, and the re-establishment of the control would carry them along together again. Consequently only an astronomer, with his chronograph measuring small parts of a second, could know of the interruption. The great beauty, then, of this system consists in the distribution of independent timekeepers of close rate, requiring no attention, and the perfect control of these by a standard which is always correct. The mechanical and electrical construction is such that they are certain in their performance, and there can be no failure to work. The battery employed is clean and inodorous, and unobjectionable in any situation. It is of the open-circuit variety; cannot possibly get out of order; is unaffected by changes of temperature; requires no attention whatever in from one to two years, and then its renewal simply means pouring out the old solution and replacing it by a new one, consisting of a few ounces of sal ammoniac dissolved in water, and possibly the addition of two small zinc rods.

The company have builded on the facts which follow, and the success attending their efforts in their present progress proves that they have built wisely and well.

No business can be properly or systematically conducted without frequent reference to its element of time, and the greater the accuracy the better. Uncertainty in the matter of exact time engenders careless habits, alike in the principal and his employes. That true business men and most of the public appreciate this, is evinced by the enormous amount of money which has been employed in the purchase of both clocks and watches, and the annual expenditure for their care and repair; and yet it is one of the most difficult things in the world to find two watches or clocks that agree. A few moments' loss of time through the error in a watch or clock is of constant occurrence, and

is often attended with the most serious inconvenience and pecuniary loss.

Astronomical observatories throughout the world, both under government and private patronage, and the efforts put forth to establish a universal standard meridian time attest the importance of uniformity and accuracy.

The practical needs are abundantly indicated. In mercantile transactions, great and small, in which punctuality enters as a factor of vital importance; in the business of bankers and brokers, with themselves and the general public, where carelessness in the matter of time frequently means loss, sometimes disaster; in manufacturing establishments, where systematic methods are essential to success; in government departments—general, State and municipal; in educational institutions; and, finally, in residences, where correct time is not only a luxury, but a convenience that cannot be dispensed with.

The Electric Regulator, Figure 1, is used as an independent pendulum clock, the time-keeping qualities of which are very fine, for the reason that the movement is so arranged that any variation in the strength of the battery current has no effect on the rate of the clock, as the armature table is connected with two little lifting rods, which, as this table oscillates over the two pairs of electro magnets, raise the impulse springs to their proper position, alternately, allowing one after the other to act upon the pendulum so that as long as the strength of the battery is sufficient to work the armatures the clock is maintained in operation and no increase of battery has any effect, for the action on the pendulum is due to the springs only, and as they maintain a uniformity of resilience, one of the principal features of accuracy in a time-keeper is thus secured. These clocks are used as a primary or master clock to control others, or may be controlled by another similar clock. They are provided with the necessary contact points for actuating the circuits of secondary clocks, each second and each minute. One of these master clocks may be seen in the Board-room of the New York Stock Exchange, and at the south end of the room will be seen a very large secondary clock, similar to Figure 5, which is driven by the regulator, the hands of which move every second, giving it the appearance of an ordinary large clock.

The Electro-Mechanical Regulator, Fig. 2, is looked upon as the crowning success of The Time Company. It contains a little motor, to be seen at the bottom of the movement, the office of which is to wind the clock, which it does automatically each hour. As the amount of energy required for this purpose is exceedingly slight, it is found that one or two cells of the ordinary open-circuit battery, such as Leclanche or Law, will wind this clock for over a year without requiring any attention whatever, thus decidedly reducing the expense of maintenance over earlier devices of this kind. The finest of these regulators are fitted with mercury compensating pendulums, although the ordinary pendulum with a metal bob and wooden rod is found to compensate fairly well, and may be considered a first-rate timekeeper. The cases are very handsome, made of hard wood, and tastefully engraved. The dial shown in Fig. 2 is of glass, in order to exhibit the interior. They are generally fitted, however, with white dials.

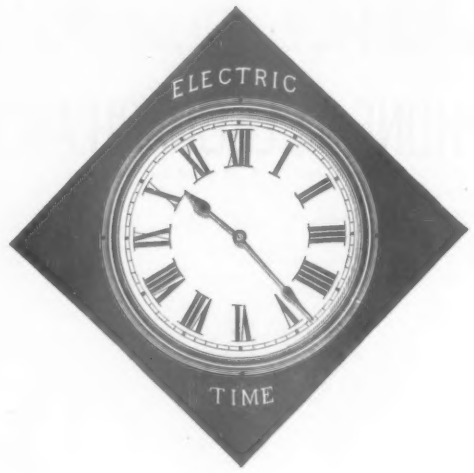
In Fig. 3 is shown the Electro-Mechanical Half-Second Dial, which can either be synchronized through its pendulum, or by a very ingenious contrivance its hands can be set each hour. The valuable feature in this secondary clock is in the fact that should one of the synchronizing currents be interrupted from any cause, the time will remain as accurate as before, owing to the contrivance mentioned. This dial is of the same size as that of the regulator, although shown on a larger scale in the drawing. Being perfectly reliable and accurate, this style is in great demand where a regulator is too large, or for any reason is not desired. The dial is handsomely engraved and finished, as the drawing indicates, and is an ornament, as well as timepiece, that anyone would be proud to have in his office.

Figs. 4 and 5 represent handsome, large dials, suitable for banks, stores, and large offices and public buildings. These receive their impulses every second, consequently the movement of the hands is the same as that of an ordinary clock.

Fig. 6 represents the style known as "jewelers' dial," particularly adapted for display windows. This very beautiful dial is of ground glass, with gold lettering and gilt hands, and is of the minute variety, the hands moving every minute.

The other figures represent the various styles of plain and fancy dials. These cuts but feebly convey the handsome appearance and elegance of the ornamental dials, some of them being finished in gold and bronze, and with various colored woods.

Throughout the system, a simple device is made use of in connection with these clocks, by which the spark at contact points, which has in the past been the bugbear of electric clocks, is entirely eliminated, thereby making the contact perfectly sure, doing away with the so-called uncertainty of electrical action. In fact, the element of uncertainty is not permitted anywhere in the work of the company, and every possible invention has been tried and perfected to do away with it; and that success has crowned their efforts, the favorable verdict of the business men of New York, and other cities who have tried this system, is the most satisfactory and conclusive evidence.

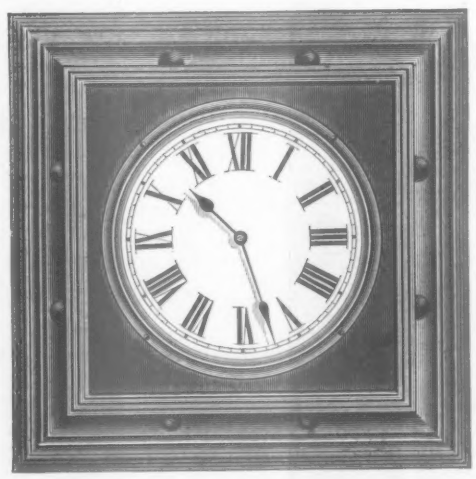


MINUTE DIAL.

MINUTE DIAL.

MINUTE DIAL.

.... The traffic receipts of the Western and Brazilian Telegraph Company, for the week ending 19th ult., were £2,480, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company.



MINUTE DIAL OF TELEGRAPHIC TIME CO.

.... The Exchange Telegraph Company is informed that it is in contemplation to establish cable communication between Auckland and Fiji. The most distant colony will thus be connected with Great Britain by wire. The proposal is being warmly supported by the mercantile interests in Auckland.

Electrolysis in the Graphic Arts.

Of all the modern methods of producing printable plates, heliogravure stands undoubtedly pre-eminent. It has many advantages over copper-plate engraving, and none of its disadvantages. For heliographic reproductions the original must be extremely sharp, either a carefully-executed drawing in India ink, or a good black and otherwise perfect print of any other device. A reversed photographic negative upon glass four-fifths or three-fourths of the original size is first made. The reduction renders the lines still sharper and more delicate than in the original. A gelatine solution, to which is added sugar, lampblack, alcohol, ammonia, and creosote is then prepared, and with it a sheet of photographic paper is coated, and laid upon a plate glass carefully leveled. As soon as the gelatine mixture has set, the coated sheets are hung upon cords, and after drying, are kept in a perfectly dry room. The quantity of the pigment is proportional to the character of the original to be reproduced, one-tenth of it being the maximum, one-fortieth the minimum; the former for fine and delicate drawings in line manner, the latter for other work. The prepared pigment paper is sensitized in a bichromate of potash bath, 1—15, and laid face down upon a carefully-cleaned plate-glass, and dried in a strong current of air. Immediately before using it the paper is detached from the glass. The exposure under the reversed glass negative is made in an ordinary printing frame, the time adjudged by a Vogel photometer. After printing, the pigment paper is taken to the dark room, and in a cold-water bath transferred to a silvered copper plate, picture side down. Removed from that bath, the paper is squeezed and dried with blotting paper. After five minutes another cold-water bath is used to wash the bichromate from the non-exposed parts. In half-an hour it is taken up, well rinsed, and subjected to a warm-water bath of 30° to 35° C. to dissolve the gelatine not acted upon, that is, to develop the gelatine relief upon the silvered copper plate. After a short time the water penetrates the pores of the paper, dissolved black gelatine oozes from the film, indicating the beginning of the development; in about 30 minutes the paper is detached, floats upon the surface of the bath, or can be lifted up with ease. The rest of the gelatine is dissolved in a few minutes, and the relief, a copy of the original, appears gradually upon the copper-plate. The development is continued in another bath of warm distilled water, till all remaining fog or dirt is totally removed from the interstices of the relief, and the picture stands out clear and distinct upon the plate. Finally, it is well rinsed with water and dried spontaneously.

To make this relief plate conductive, powdered graphite is spread over it with tampon and a soft brush; afterwards it is placed on the cathode of a Daniell trough apparatus, and a zinc anode used to accelerate the precipitation of copper. In an hour or less the heliographic relief plate is sufficiently covered, and the plate is taken up, cleaned and rinsed, and again placed in the trough. To promote the force of chemical action, caused by the electric current, an iron anode is inserted. After twenty to twenty-four days the plate will be of the desired thickness, and is, therefore, then taken from the trough, rinsed with water, and dried; the edges are filed off, and the patrix removed from the matrix. Both plates are well washed.

If the plane of the gelatine relief has been perfectly clean, and free from any tone, the intaglio plate is also smooth, lustrous, and printable. Matt spots are wiped off with oil flannel and rotten-stone; tone and impurities are scraped and burnished; other defects, which but rarely occur, are retouched with needle and graver.

The first impression made from heliogravure plates are always rough, and retouching them should not be undertaken till a number of prints have been made. They are in every way equal to engraved copper-plates, and with them there is a great, almost incredible, saving of time. Heliogravure plates, maps of the Austrian Empire, made in fifteen years, would have taken generations to engrave. Before large editions are printed galvano-plastic reliefs are taken from the intaglio plate.—*Photographic Times.*

Electricity in Vacuo.

By C. C. Haskins.

Scientists have been at loggerheads for some time relative to the electrical capacity of rarified gas—partial and practically perfect—vacuum. Experiments, which to the minds of some of these were convincing as possible, have been shown by others, through subsequent illustrations, to have been either wanting in some noticeable particular or faulty in philosophy.

Some of the later of these experiments have shown curious results; and, as many of these have in them the elements of both simplicity and comparative cheapness, I have collated a few of these for the columns of the Review. A large majority of the following experiments are due to the fertile brain of Gaston Plante, the originator of the storage reservoir, or secondary battery, who has, perhaps, done as much as, if not more than, almost any scientist in the comparatively untrodden realms of electricity, solely for the love of the labor and the advancement of pure scientific knowledge.

For the first series of experiments a Geissler tube, about five or six inches in length, will suffice. The terminals of this tube are attached to the secondary wires of an induction coil, the primaries being in circuit with a battery sufficiently large to give a good effect in the tube. While the current is passing, if the outside of the tube at a point about equidistant from its extremities be brought quite near a point from the conductor of a powerful static machine in action, the illumination of the Geissler tube will cease. The static machine contiguity having been of only momentary duration, the illumination will be almost instantaneously renewed; but if of longer duration, it will delay this for a greater length of time, while a position near the point continuously maintained for from four to five minutes will retard the re-illumination for fully half an hour, although the induction apparatus is in constant action in the interim.

Now, having extinguished the illumination as above, if we reverse the static influence by approaching the opposite pole of the machine, the illumination will be instantly renewed. These reversals may be repeated at will

2d. Hold a Geissler tube, grasping it firmly about its middle with the whole hand. Bring it within two or three inches of the machine; this distance may be varied until the desired effect is obtained, the result depending upon the capacity of the machine, state of the atmosphere, etc., and after a short time suddenly withdraw it, and make contact with the other hand at one of the terminals of the tube. A shock will be felt, and the tube will show an instantaneous illumination. A little care should be exercised in this experiment, which, while not at all dangerous, is startling in its effect from the suddenness of the shock. "Try a sample first, and increase the quantity to suit the case."

3d. Having in the first experiment extinguished the illumination, while there is a galvanometer and telephone in the circuit, the wires of the latter being crossed to cut it out, if we listen at the telephone and separate the cut-out wires, a noise will be heard in the telephone, the galvanometer will show an instantaneous deflection, and, under favorable circumstances, a flash of light may be seen in the tube. These experiments are best shown in a darkened room.

Incandescent lamps may be made to show some peculiar phenomena of static charge.

4th Cut the terminals of an incandescent lamp close off at the entering point of these. Insert the neck of the lamp in a vessel of wax, thus perfectly insulating the inner portion of the globe from contact with the outer air. If, now, the globe be briskly struck with a bit of cat-skin with the fur on, or even a piece of woolen cloth, flashes of violet-colored light will be seen in the interior of the globe at each blow. After a number of blows with the above result have been struck, if the glass be touched by the finger, a spark is discharged.

5th. Attach a piece of tinfoil, about the size of a quarter of a dollar, to the face of the globe opposite the terminals of such a lamp.

Fig. 3.—Electro-Mechanical Half-Second Clock.

Sparks from a static machine upon this foil will charge the lamp, which may be discharged by the finger. Remember the caution in experiment No. 2.

6th. With the same care, charge and discharge the lamp direct through its terminals.

7th. Connect the two terminals of the lamp as above to a metallic handle. Hold this to one pole of the machine. Bring the tinfoil disc to the opposite pole of the machine, near enough to receive the sparks. At each spark the globe will be lighted up, the form and color of this illumination depending upon the direction of the current.

If the foil receive the sparks from the pole of the machine, the illumination will appear as a violet-colored yerb, extending from beneath the disc to the opposite or bottom side of the globe. A reversal of this current direction will induce a yellowish green light concentrated at the bottom of the globe.

Discharging the globe by either contact with the hand or the opposite pole of the machine will reproduce these illuminations, the color and form depending, as above, upon the direction of the current flow.

Fig. 4.—Large Second-Movement Circular Dial.

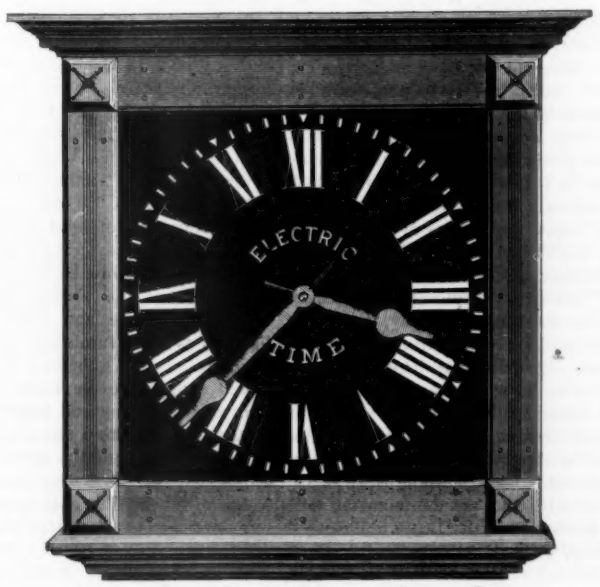


Fig. 5.—Large Second-Movement Square Dial.

From the above experiments, we learn that a vacuum has excellent capacity, both for conductivity and for static charge. In the first experiment, we have an example of retardation, resulting from the attraction existing between charges of different polarity or potential. The second shows the capacity of a vacuum in the rôle of internal armature in a Leyden jar, the hand replacing the outer armature. The lamp, insulated by wax, on being struck by the cat-skin, receives a charge, the inductive action of which is shown by the flashes within the globe.

In all cases, the direction of the current is indicated by the form and hue of the illumination.

Under favorable circumstances, a pleasant and instructive evening entertainment may be based upon the above experiments, and variations, suggested by the exercise of a little ingenuity, may materially add to the exhibit. Some very pretty results, for example, may be obtained, under favorable circumstances, in connection with the above apparatus, for parlor exhibits, with static charges arising from sliding over the carpet. A checker or ironing board, on glass tumblers, will make a good insulating stand, and a party standing on this may be charged with static electricity by striking the back with a fur cape or collar, and this charge may be partially discharged into an incandescent lamp, or through a Geissler tube, to another party similarly insulated.

Priority of Invention.

The following are points in decisions on priority of invention:

The party who first reduces an invention to actual use is entitled to the patent for it, although the other party may have first conceived it, if he did not exercise reasonable diligence in reducing it to practice.

If the party who first conceived a machine followed up the idea diligently, and was the first to reduce it to actual practice, he is entitled to a patent for it, although his competitors had complete working drawings of it previously prepared, and had obtained a patent.

Whoever first reduces an invention to practice and makes an application of it to use, will usually be held the prior inventor.

In order to defeat a patent, the courts require it to be shown that another not only conceived the invention in dispute before the patentee, but was also the first to perfect and adapt the same to practical use, or was using reasonable diligence for that purpose.

The parties who first embodied an invention in a machine which they kept in operation afterward for actual use, besides manufacturing and selling other machines, are *prima facie* entitled to that patent.

He is the inventor, entitled to the protection of the patent law, who is first to complete the invention and publish it to the world, and not he who confines the knowledge of it to his client.

Where an invention consists of a combination of elements, the date when all the elements are combined is the date of the invention.

When one is first to conceive an invention, but throws aside all evidence of the conception, makes no effort to complete or introduce it to the public, and delays making an application for a patent for nearly four years after another has brought it into extensive use, he has no standing as an inventor.

*** By direction of the secretary, a letter was written to the architect of the United States Treasury, instructing him to cut down from the roof of the Treasury all telephone and telegraph wires still remaining there, and to wind them up on the nearest street pole, so they will not be in the way of foot passengers or horses. The order was given some time ago for all the companies to take down their wires, but only some of them complied. Those remaining will be cut down.

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We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity and those engaged in Electric Lighting on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

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We understand that one of the prominent electric light companies of this city has requested its licensees not to unite with the National Electric Light Association. We wonder what this company fears? A similar edict was sent forth by another parent company prior to the meeting in Chicago last February, and every licensee receiving the notice took particular pains to be present. If any parent company is afraid to have its licensees meet and confer with other electric light manufacturers and operators, no stronger or more suggestive reason for their attendance could be presented.

Regarding prevalent rumors of a prospective consolidation of the Baltimore and Ohio Telegraph Company with the Western Union, President D. H. Bates, of the B. & O., says:

"No negotiations of any kind have been made with any company regarding combination. The Baltimore and Ohio have not been running behind in their business monthly, as has been stated, to the extent of $50,000. No month during the past year has the company failed to pay its expenses and realize a profit. I furthermore contradict the report that President Garrett of the Baltimore and Ohio Railroad has been negotiating for a compromise with parties in London."

WHY GO ABROAD WHEN YOU CAN DO BETTER AT HOME?

Upon the notorious Howgate's disappearance from the United States Signal Service and Supply Department, American manufacturers of cables and wires were under the impression that there would be no further trouble in getting a fair show for competition for Government business, but it is found that the English element still prevails there, and that all supplies of cables of insulated wires for Government use are still purchased in England and admitted to the United States duty free. This seems very strange, as many tests and trials have proven the fact that better cables are being made in the United States, and have been made for the past three or four years, by the Western Electric Company, A. G. Day, Bishop Gutta-Percha Works, Holmes, Booth & Haydens, American Electrical Works, Bridgeport Brass Company, Ansonia Brass and Copper Company, Electrical Supply Company, Triplex Company, and others, whose wires and cables have been in use in competition with those of English make, and have stood all tests to which they were put, and, in several instances, proven superior to those imported. It is evident that it would be a good time to have some light shed on the manner of letting these contracts. Why are not American manufacturers given a chance to bid? and why are the specifications so worded as to particularly benefit the English manufacturers? Is there a robust colored gentleman in the cord-wood?

We believe the present an opportune time to investigate this matter. We had hoped that Howgate's methods had passed away with him, but as it seems likely that the gentleman himself is about to return and be forgiven, perhaps his methods with modern improvements have preceded him.

THE TELEGRAPHIC TIME COMPANY.

The REVIEW is pleased to call the attention of its readers to the new electrical industry presented in its columns in this edition. Electric time, as a successful business enterprise, is now beyond the realms of conjecture and uncertainty. The Telegraphic Time Company have brought it to such a perfect state that its introduction is all that is required to create a decided and almost universal demand. In cities where companies have been organized, the annoyance is in not being able to always promptly fill the orders for electric clocks, so numerous are the applications from subscribers. Our own experience for eight months past with one of the clocks of this company is such that we can most cheerfully recommend the system. Electric time is a valuable element in business, and the perfect satisfaction it has given this office makes it easy to understand its appreciation by the public. One reason for its popularity may be found in the extremely small cost to the subscriber at which electric time can be furnished; and as with this is given absolutely accurate time every minute, day and night, the success of electric time becomes established and secure.

To the sagacity and excellent management of J. W. Duxbury, vice-president and general manager of the Time Company, the present advanced position of electric time may be attributed. Realizing that there was a great future for it, he secured and perfected the present system, enlisted capital to aid in carrying it through, and is now in position to prove the correctness of his views by the rapid extension electric time is enjoying. Associated with him are the following well-known gentlemen on the Board of Trustees: Alfred Ray, R. M. Pulsifer, Alfred A. Reed, Henry Howard, C. R. Weeden, F. E. Spooner, C. H. Pond, James Hamblet.

THE COLONNE-SOLEIL.

The project of lighting an entire city from a single electrical tower, which was recently brought to the attention of the French Academy by MM. Bourdais and Sebillot, is one which, very naturally, is attracting considerable interest on the Continent of Europe. Generally speaking, neither the Parisian nor the Provencal uses gas in his lodgings, but candles; gas being too expensive, and the cost of lighting a whole city's streets with gas is, in these times, found to be a very severe tax on the people. Hence they look with favor upon any project which will give them even a modicum of light, if at the same time it gives them a modicum of cost.

Speaking of this project of lighting a whole city from a central or *colonne-soleil*, as it is called, or by several of them, the *Bulletin International* says that recalling what has been done in this direction in America—for our contemporary observes that the example of the Americans in electricity, as well as in politics, always carries weight in Europe—there seems much hope from such a project, though in new cities, like those in America, the streets are apt to be straight, and to intersect each other at right angles, and consequently more easily to light from towers. In France, as in most European cities, the streets are often both narrow and tortuous, having arches and other obstructions to free access of light. It is possible to set up a great installation at the intersection of a large number of streets, having hundreds of carcels of intensity, which, though it almost blinds those at the foot of it, and does not clearly light up the extreme limits of the city, can at least be seen from great distances. In America, says our contemporary, electric lights are used in some of the cities of not unusual intensity. In New York, for example, these lights are from 50 to 75 carcels, and take the place of gas in the proportion of one electric light for 6 or 7 gas jets, not more. But no one, until the arrival in the field of Messrs. Bourdais and Sebillot, was bold enough to suggest the lighting of a great city from a single light-tower.

Our contemporary next essays to compute the amount of light required to illumine a great city like Paris.

It says: At Paris, if we refer to the accounts rendered by the Parisian Gas Company, December 31, 1884, we find that the lighting of the public streets required 50,516 ordinary gas lamps; 1,307 jets intensified to 1,400, and of 875 liters (a liter is 61.028 cubic inches); 2,160 jets intensified, placed at the entrance of great stores, restaurants, cafes, etc.,—the whole corresponding in intensity to 80,216 jets, each of about one carcel. The system of sewers which have also to be lighted in Paris, is in its total length 1,422 kilometers. Altogether, the total surface lighted by gas was 17,000,000 square meters. The gas jet was found to be most efficient at a height of 6 meters from the pavement, and hence the total amount of space lighted by the gas company was 102,000,000 cubic meters. This would be one carcel for 1,270 cubic meters.

In the case of a single light-tower of 2,000,000 carcels intensity, the light would be distributed in the shape of a pyramid, having the surface of Paris for a base, and for altitude, the height of the *colonne soleil*. viz: 300 meters. The area of Paris is 72,000,000 square meters. The volume of the pyramid would be 7 milliards, 200,000,000 of cubic meters (7,200,000,000 of square meters), and the quantity of light furnished would correspond to one carcel of 3,600 meters.

It would, therefore, be necessary to triple the power of the electric light tower in order to secure the same amount of light as is now furnished by gas. But it would be an error to believe that even this would suffice, because those points where light was most required would, on account of their distance from the source, the intervening shadows, and the opaqueness of the atmosphere, be left in deep gloom.

Again, is it feasible to concentrate upon a circumference of 36 meters of development 100 focuses, each of 20,000 carcels intensity, without causing there an excessive elevation of temperature?

M. Corunault, of the Society of Civil Engineers, has justified this query by the following: The 10,000 H.P. employed to feed the electrical focuses will, to the extent of 80 per cent. at least, be converted into electricity. That is to say, every second there will pass 8,000 H.P. converted into light and heat in the regulators. According to the principle of the conservation of energy, this 8,000 H.P. corresponds to 1,400 calories per second, or thereabouts.

Let us suppose, for the purpose of illustration, that the focuses shall be fixed in a dome having a diameter of 20 meters, or of 2,100 cubic meters in volume. The specific heat of the air being 0.237, the 1,400 calories would raise the temperature 1° Centigrade a second of 5,900 kilogrammes of air, and, consequently, it would raise the temperature of the volume of air in the dome 2.16°. In an hour the temperature would reach 7,776° Centigrade.

It would, no doubt, be possible to arrange to dissipate this heat, but the fact that reflectors and lenses must be used, would have the effect of concentrating the rays to a dangerous extent. If it be urged that we should distinguish between the phenomenon of heat and the phenomenon of light, the answer is that in large bodies thus joined, the relative values have never been ascertained.

For these, and other reasons, neither Paris nor any other great city is likely to be illumined by a single light-tower or *colonne-soleil*.

ELECTRICITY IN THE BLEACHERY.

The various and diverse applications continually being made of the electric current would almost lead to the conclusion that there is no limit beyond which this wonderful force may be applied. We hear of its use in the sugar-house, the dairy, the vineyard, the hospital, the tannery, the arsenal and hundreds of other places. New applications are continually coming to light, until, at times, it seems to be as ever present in sea and land and atmosphere as alcohol is. The latest application of electricity is in the bleachery, where M. Bonneville, as we are informed by *Bulletin International des Telephones*, has successfully used it for the regeneration of the baths which have already served in bleaching tissues and fabrics.

The operation is thus described: One pours in a cold solution to the $\frac{1}{100}$ of brome, one per centum of caustic soda to 36° Baume, or an equivalent quantity of an alkaline. The vegetable tissue previously moistened, is plunged into this solution and remains there until the time when it is found to be discolored. It is now passed into the acidulated water and rinsed. After numerous operations of this kind the bath becomes exhausted. This may be resuscitated by adding one per centum of sulphuric acid, or of nitric, which liberates the brome. Now caustic soda is put in in order to reproduce hypobromite of soda. The hydrofluosilic acid during the formation of the bromures and bromates gives an insoluble fluosilicate of soda which is easily eliminated by decanting. In this case there is neither sulphates nor nitrates mixed in the bath. Now, if two electrodes of carbon are placed in the solution connected with a battery, the active oxygen is constantly renewed by the regeneration of the hypobromic acid. It has been proved that a bath which has been entirely exhausted can be regenerated by the passage of the electric current and the same action takes place with the chloride and its constituents.

M. Bonneville recommends the employment of brome and of the hyperbromites for the bleaching of various vegetable tissues and fabrics, the regeneration of the baths by the acids more particularly by hydrofluosilic and the restoration of the power of the bath by means of electricity.

It is said that this process has been used with not a little success both in France and Belgium and the news of the discovery has made, so we learn, not a little sensation among the bleacheries of Ireland, for there especially, bleaching is caried on on a grand scale, and the ability to use the chemical bath not once but a number of times, if the process may be employed on a large scale, cannot fail to make a very considerable difference in the price of bleaching.

GENERAL WESTERN NEWS.

Cement-lined water mains, as these have been laid in some cities, are unsafe conductors to which to attach lightning rods. The annual report of the Water Commissioner of Fitchburg, Mass., says that "during a violent thunderstorm on the 6th day of June two houses were struck by lightning, one on Burnap Street and one on Milk Street. The electric fluid in both cases followed the service pipes to the four and six-inch wrought iron cement-lined main pipes, and when it reached those mains its path of ruin was fearful. In some cases a length of pipe would be split from end to end, others would be perforated with holes, which, in almost every case, indicates that the fluid passed from the outside to the inside of the pipe. Nearly every joint on the 2,000 feet of its course was opened, and one gate and two hydrants were so badly damaged as to be useless."

These mains were made in sections of 8 feet, lined with cement half an inch thick, and covered the same depth on the outside with similar material. The section joints were made without perfect metallic contact, a sleeve filled with cement about six inches in length, covering each connection, making a water-tight joint, a space of from one-eighth to one-fourth of an inch separating the sections. The Commissioner asks: "Cannot some electrician give us a plan of protection?"

The trouble was evidently not a want of carrying capacity or conductivity in the mains, for the service pipes proved fully competent to carry the charge without detriment, and these were of much less diameter, of course, and hence had less carrying capacity.

There are several reasons why such mains are incapacitated for ground connections for the discharge of electricity of such extremely high tension as that of thunderstorms.

The internal lining of cement is to an extent an insulator electrically separating the pipe from the water within, which would be competent to carry off the discharge quietly and noiselessly, dissipating it to the ground at its many points of contact, were it permitted so to do.

The external covering of cement, which is also a barrier to the free passage of the current, greatly increases this difficulty, and the separation of the sections from each other still further decreases the carrying capacity, inasmuch as there is virtually at any point only an insulated section of pipe of four to six inches diameter and eight feet length, electrically cut off from the rest of the main and the ground. But, in addition to all this, each pipe section becomes from this double insulation a powerful Leyden jar of large capacity.

The high tension of a thunderstorm current capable of discharging through a thousand feet or so of atmospheric air, which is but a poor conductor, even in a severe rainstorm, for the drops are not contiguous, is capable of forcing its way readily through this cement, which is a partial conductor, and thus uniting the two polarities of current, precisely as the charge in an overloaded Leyden jar will pierce the glass and equalize the potential between the outer and inner coatings; and this route through the partially insulating material on the two surfaces of the pipe presents a quicker and more feasible means of dissipation or equalization of the current than the slower dispersion of the charge by absorption in the comparatively dry earth surrounding the main at the service-pipe connection.

Every telegraph and telephone man of even limited experience knows the difficulties which have occasionally to be surmounted in placing ground connections for lines. Gas pipes are often almost worthless for this purpose. The fault is generally to be found at the joints, where a thin film of paint—precisely the same in effect as cement in the Fitchburg pipe joints—destroys the continuity of the metal, and partially or wholly breaks the electrical path. Water pipes containing, as they do, a conductor of electricity of great area, which somewhere must be in contact with earth, and which bridges over all poor joints, are greatly preferred. But, in many localities, where neither gas nor water pipes are to be found, to get a good ground connection is a labor of much time and trouble, and there are plenty of cases known to telegraph men where a line of wire has been carried, in some instances, many hundred feet, to a well or other supply of constant water, and sunk in this with a goodly-sized plate or bar of iron attached, before a good ground connection was made.

Now, if, with the comparatively low-tension currents used in telegraphy and telephony, such care and trouble are sometimes necessary to insure good ground connection for a minute fractional force, imagine what are the necessities where a force millions of times greater is interfered with in its journey either to or from the earth.

The mental capacity of the ordinary lightning-rod man, who sticks his "thunder-pole," as they sometimes call it, a few inches into the dry sand, makes his connections of rusty iron links, and expects an impure iron rod thus connected to be capable of carrying the discharge from one of the Almighty's huge condensers, is incapable of appreciating the mechanical force of the power he is trifling with, and in ninety-nine times out of one hundred greatly increases rather than diminishes the danger in every exhibit of Nature's electrical force.

The renewal of the injured mains, in the case mentioned, cost, in round numbers, $1,700, and the report states that this is the fifth mishap of this nature which the company has experienced. In 1877 2,000 feet of these mains were required to be replaced.

The only remedy which appears on the surface is to make adequate metallic connections at all the section joints of the pipe, and similar contact between the service pipe, the main pipe and the water flowing within these—in other words, a complete and sufficient path for the current, in either direction, between the water and all pipes of whatever dimensions.

The electrical disturbance of the 8th inst. was one of the most wide-spread geographical range, and intense severity in the annals of American meteorology. It extended from New Hampshire to Minnesota, taking on various forms of manifestation in different localities. Madison, Wis., which has heretofore been considered exempt from this sort of disaster—a protection claimed to be due to the peculiar topography of the locality—was singularly and painfully taught the error of its assumed immunity. Extremely high temperature, violent wind and copious rain, accompanied by vivid lightning with roaring thunder—a regular tornado—was their portion. Houses were unroofed, and over 100 shade trees were uprooted.

At Sparta, Wis., cars were picked up off the track and dumped in the ditch—in some cases lifted across the main track without being uncoupled or seriously damaged. The stock of a lumber yard was sown broadcast over its neighborhood. Churches were wrecked, chimneys without number were thrown down, and miscellaneous minor catastrophies of every conceivable nature were abundant.

Tomah, Wis., suffered in a similar manner. The town of Schofield, near the former, is said to have not a single building left uninjured. Farm-houses, crops, fences, outbuildings, orchards, etc., are damaged to a greater or less extent throughout a line from N.W. to S.E. Wisconsin. The tobacco crop of the entire State—which is not an inconsiderable product, by any means—is said to be almost completely ruined.

Minnesota came in for her share of disaster. Monticello reports a cyclone, which, in the form of a green, funnel-shaped cloud, passed five miles north of the town, thoroughly demolishing and scattering an inhabited dwelling along the prairie. Knives and forks were found 300 feet from the site of the ruin. A gentleman took refuge in a clump of bushes, and was saved by a rare freak of the cloud, which jumped completely over him without molestation. In the cloud, as it passed, he distinctly saw timber and other debris, dancing and whirling to the merry roar. Five hundred yards farther on the cloud descended to the ground again, picking up pieces of a stable which it demolished, but leaving a dwelling just outside its path uninjured.

In Illinois, from Champaign, Bloomington, Rockford, Gibson, Joliet and many other localities the rain, wind and lightning, together or separately, worked sad havoc with bridges, tracks, wires, telegraph and telephone instruments, occasioning the loss of hundreds of thousands of dollars, and recording a very formidable death roll.

A Mrs. Brandt, of Jamestown, Dak., who passed through the storm in Wisconsin, was rendered insane by fright.

The assistant custodian of the Government building here, in which the United States people placed incandescent lights last year, has received imperative orders to discontinue the use of the plant until further notice from Washington. This action is not from any dissatisfaction with the light; on the contrary, the Post-Office employes have, since the installation of the plant, been in high glee, and profuse in their commendation of the light, its better quality as to hue, and its freedom from heat when compared with gas. The item of expense alone has induced the move—the difference in favor of gas for the same service being about $1,000 per year. The gas bills were formerly about $19,000 per annum, the electric light pay roll being $8,000; supplies and incidentals, $12,000; or a total of $20,000.

It is estimated that the difference in thermal effect in favor of the electrical illumination is about 20° Fahr. With such a night as that of the 8th instant, when half the city slept in "sweat and agony" for covering, the thermometer ranging from 90° up, an addition bringing this to the level of 110° would rather tend to dampen the mental ardor, if it did not the physical condition, of the Post-Office clerks, who are already howling their disapproval of the change.

During the recent strike of car-drivers and conductors, which fortunately terminated without much mischief, but with considerable discomfiture of the socialistic element, the police telephone and signal system rendered most efficient aid in handling the municipal department of the city. "Evil-doers have a wholesome dread of wires which talk, which hold command of arms that at their quiet bidding rush to conquer or dispel the wild, unlawful gatherings of passion-angered men."

The new Hurst's Hotel, St. Louis, has lately contracted with the Western Electric Company for one of their large hotel annunciators, and also for their improved system of hotel fire alarm. This system has recently been introduced into the Lindell Hotel of that city, and is pronounced a great success in every respect.

The Central Union Telephone Company have declared a quarterly dividend of $1.50 per share, payable 25th instant. As the stock has latterly been hovering around 60 cents, with very little to be had, it is a good 10 per cent. investment, and is much sought by would-be purchasers, who are lucky if they can buy.

Chicago.

ELECTRIC LIGHT COMBINATION.

BOSTON'S THREE COMPANIES TO POOL THEIR ISSUES WITH A CAPITAL OF $700,000.

After a year's negotiations the three electric light companies of Boston have determined upon combining their forces. They are the Brush Electric Company, the New England Weston Electric Company and the Merchants' Electric Light and Power Company. The new combination will be known as the Union Electric Light and Power Company of Boston, and is to be organized under the general laws of Massachusetts, with a capital stock of $700,000, the par value of the shares to be $100. The stock will be divided as follows:

Brush Company, $250,000; Merchants', $225,000, and Weston, $225,000. It is estimated that the plant of the three companies has cost $1,000,000. The Brush Company has a debt of $91,000, the Merchants' a debt of $47,000, while the Weston Company is free from liabilities. The consolidated company will assume these debts and put the same in fifteen-year bonds.

The capacity of the three companies for lighting at the present time may be stated as follows:

Brush Company.....	700 lights.
Merchants' Company.....	600 "
N. E. Weston Company.....	600 "
Total lamp capacity.....	1900 lights.

It may be added that the stations of the three companies have a steam capacity for at least 500 more arc lights. In the aggregate the three companies have about 500 miles of wires erected in the city. Under consolidation, at least one-third of these wires can be dispensed with, leaving that amount on hand without further cost to the new company to extend its business. It is probable that the central stations of the three companies will all be run for a time, but if it is found more economical to do the business with two, one of them will be discontinued.

J. E. Hudson, attorney of the American Bell Telephone Company, succeeds Theodore N. Vail as general manager.

Electricity and wind seem to be vying with each other for the ascendency, judging from recent storms. The telephone and telegraph people are heavy losers in consequence.

The Committee on Judiciary of the Lower House has decided that the telegraph and telephone wires in the City of Detroit must go underground. If it will also decide to make the wires work satisfactorily underground, the telephone companies will appreciate the little kindness as they go along.

The property of the Bankers and Merchants' Telegraph will be sold under foreclosure on July 27. The reorganization committee will purchase the line, and reorganize the company on a basis involving the conversion of the present Bankers & Merchants' bonds into bonds of the new company at 50 per cent. of their face value, at the same time one share of the new company will be issued for each five shares of present stock.

The Lawrence, Mass., *American* contains the following: "One year ago the Edison Electric Light Co. placed in the *American* office one of their motors, and connected it with their works on Common street; the big belt was removed from the driving wheel of our steam engine, and put upon the little electric motor, and the entire power to drive all the newspaper, book and job presses, elevator, etc., of the *American* has since been uninterruptedly furnished by electricity; the fires then permitted to go out under the steam boiler have not since been relighted, nor has there been the slightest loss or suspension of the full power required from that day to this. The *American* was the first daily newspaper in the world to be printed by electricity, and after a year's trial, we consider it the most unvarying and satisfactory power we have ever used."

The Lehigh Valley Railroad about ten days ago put an electric headlight, of the American Headlight Company, on to the locomotive Robert Sayre, one of the largest engines running over the New York division. The brilliancy of the light made a sensation along the route, and on the run in the early part of the evening, and even as late as 11 o'clock at night, crowds gathered at the railroad stations to see the new headlight. A small dynamo is on the sideboard of the engine, close to the cab. It is run by a disc engine, which gives it 650 revolutions a minute, which is double the power needed for the single lamp carried in the headlight. The engine is attached in the manner of an air-brake attachment on the other side of the main boiler. The wires are insulated with rubber, but are intended to be run through the hand-rail. The light itself is 2,000 candle-power. It swings on pivots, and the claim is made that with the force feed it never flickers. The carbon points are kept in their places by the electric feed.

Telephonic News

*** Detroit is now wrestling with the question of putting all the telephone and telegraph wires under ground. Why not have a commission appointed?

*** George L. Phillips, well known in the telephone field, accompanied by his family, sailed on the Germanic Thursday of last week for Europe, where he will remain for three years, educating his children and enjoying a rest.

*** It is proposed to establish a telephone system in Boston independent of the general telephone system. The idea is to use the fire alarm wires and to put a switch-board into the fire alarm office, and use this exchange for city business, fire alarms, police calls, etc.

*** There seems to be a warm time telephonically at Indianapolis at the present writing. A letter from Vice-President Louderbach, of the central Union, was read, stating that it was the purpose of the company not to take out any telephones until it had an opportunity to present to its subscribers a proposition which is, in its judgment, so fair and reasonable that it will meet their approval. The whole matter has been referred to a meeting of patrons.

*** In no part of economy are we divorced from wire. It is our slave, and an ever-present master. Sleeping, we repose on wire mattresses. Eating, we see food which has passed through sieves, and which is sheltered from insect appetite by wire covers. Calling, we pull wires to ring curled wire gongs. Traveling, we are conveyed by cable or electric railways, hoisted by elevators hung on wires and hurried over wire bridges. We announce our coming by telegraph or telephone wires, and we tread our way by night through streets lighted by means of electric cables. Across our fields are strung thousands of miles of barbed wire. Our clocks are set by wires, our watches run by wires, our books are stitched by wires, our pictures hung by wires, and our politics managed by wires. Forty years ago there was not a telegraph office in existence. To-day they number over 60,000. Ten years ago the telephone was not in existence To day there are 330,000 in use in the United States alone.

*** Judge McKennan, of the U. S. Circuit Court, in granting the American Bell an injunction against the Western Pennsylvania Co. at Pittsburgh last week, spoke to the following effect: "We will now consider the case as settled for the present. Now, I say that this case and the ruling is perfectly consistent with the previous rulings of the court; and, under the circumstances, is there any reason why this case should depart from the usual decisions? These defendants have entered upon a course of infringements; and more than that, they began a war against the Bell Company. The defendants commenced for the very purpose of inviting a suit. They have stood up and said, 'Bell, you are not the inventor, and we will fight you.' The ruling of the court is that an injunction is allowed." This sudden ending of what promised to be a very protracted case, created quite an excitement for a time, and when the news spread on the street a large crowd collected in the court room. All was bustle and confusion. Lawyers were busy gathering up their books and papers, while those having charge of the telephone display began to pack up their instruments preparatory to "silently stealing" homeward. By the granting of the injunction the Western Pennsylvania Company will be compelled to take all the telephones out of use, take down their wires and await the decision at the final hearing. Mr. Storrow, counsel for the complainants, said they would insist on such action, and would not be satisfied until they got it.

*** Two German Post and Telegraph officials, who lately went to Brussels in order to make themselves acquainted with the application of the Van Rysselberghe long-distance telephone system to the telegraph lines of Belgium, have complimented the Belgian telegraph engineers on the practical arrangements which they made, and Herr Elsasser has given a lecture on the system, published *in extenso* in the *Electrotechnische Zeitschrift*.

*** The case of the American Bell Telephone Company against the Western Pennsylvania Telephone Company, which was on trial in the United States Circuit Court, Pittsburgh, ended last Wednesday, the court granting a preliminary injunction against the defendants, as we briefly announced in our last issue. The latter have 600 telephones in use in Pittsburgh, which they will now be compelled to take out. An appeal to the United States Supreme Court is considered out of the question, as two or three years would elapse before the case could be reached. The Western Pennsylvania people consider further litigation useless, and will retire from business permanently.

*** The celebrated old Moorish edifices, Pena Castle and Royal Palace, in Cintra, Portugal, were recently telephonically connected by the Edison-Gower-Bell Telephone Company of Europe. As all who have visited the favorite summer resort of Cintra are aware, the castle is built on the summit of precipitous rock mountains, ascent to which is impossible except by means of the circuitous pathway. The wire employed was No. 14 B.W.G. steel, jointed to a few yards of No. 8, on either side of the insulator; the first of the latter was fixed high up one of the "Champagne" chimneys of the Royal Palace, thence to the ruined Moorish Castle, and thence to the Pena Castle. Those who have visited Cintra can easily understand the enormous difficulties which would necessarily be encountered in passing the line wire over the thousands of trees which cover the intervening ground, and also on account of the dangerous nature of the rocks for any ascent other than by the beaten circuitous track. To overcame these difficulties, a novel innovation in the passing of telephone wire was adopted by Mr. Alan Danvers, the company's engineer. Rockets, with thin cords attached, were fired over the rocks and trees, the line wire being then attached to the cord and pulled after it.

*** Women seldom trouble telephones, perhaps because they have no faith in interviews where the fascination of actual feminine presence is wanting, but once in a while an enterprising female is found, who can speak her mind freely through one of these modern conveniences. Such a woman called up a reporter on a certain paper in this city, the other day, but the reporter didn't recognize "the sweet, low voice, and excellent thing in woman," and thought, probably it was some man who wanted to give the particulars of the last slugging match. So to the "hello" of the lady he yelled out, "Well, what der yer want? Why in thunder don't yer say what you've got ter say, and not stand there yelling 'hello' till you're black in the face?" His countenance was a study for three painters as a feminine voice replied: "I beg pardon, but I am Miss Blank, and I would like to inquire if the prize offered in the *Telegram* for the best story"—He was up in a minute, bowing and scraping to the wooden instrument, and saying in his blandest accents, "Excuse me, madam, I thought it was ——, I shall be most happy to write you a note explaining—you must not think I was intentionally rude." And now, the lady telephoner is relating to all her friends, what a change came over the spirit of that reporter's dream, and is chuckling over the fun she has extracted from the episode.

The Cumberland Telephone Company Explains Its Position in Regard to the Law.

Below is published a notice that has been sent to the patrons of the Cumberland Telephone Company:

"This company recently gave notice terminating on June 30th, 1885, all Indiana subscribers' contracts, the primary terms of which had expired. The local managers will now present to such subscribers new contracts for the term of three months, which it is hoped may be satisfactory and effect a continuance of their business relation with the company.

"The law recently passed by the Legislature of Indiana, fixes the price of the rental for the use of a telephone only, whereas, in each case, there are furnished in addition, many other things which go to make up telephone exchange service, such as lines, batteries, magnetic bells, central office apparatus, constant labor of agents and employes in maintaining the same, services of operators at central offices, etc. The company proposes to conform to the law in the price of rental, and to make such charges for other material for its services as are reasonable and proper.

* * * * * * * * *

"It is not intended to discuss at this time the legal question involved, but it is reasonable to assume that telephone subscribers would bitterly oppose the enactment of laws ragulating prices at which they should sell their own labor, products, merchandise, machinery, etc., regardless of the cost of production to them, and the injustice of such rules applies with equal significance to the telephone business.

"The company will aim to treat all subscribers alike under similar circumstances, and to make rates uniform for each class of service in any given city or town.

"CUMBERL D TELEPHONE & TELEGRAPH CO.
"O. F. NOEL, Pres."

A Tubular Electric Conductor.

In the accompanying drawings is represented a conducting-cable, the invention of H. D. Rogers, 75 Maiden Lane, this city. This underground electric cable, described below, possesses many new and novel features, and seems to be a desirable one for the purposes intended. The electro-plating of the inner insulation is a new feature in the manufacture of electric cables, and is presented as one of the latest improvements to-

Fig. 1.

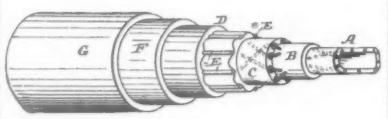
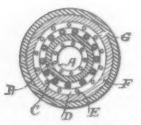


Fig. 2.



THE ROGERS TUBULAR ELECTRIC CONDUCTOR.

wards overcoming the many objections made to underground cables. To those interested in this matter, further information will be cheerfully given by Mr. Rogers.

Fig. 1 of the illustrations is a side view with different layers exposed, and Fig. 2 a cross-section.

A is the central hollow conductor or tube; *B*, a coating of insulating material thereon; *C*, a second tubular conductor enveloping the insulating coating, *B*; *D*, insulating material; *E*, a series of conductors embedded in said insulating material, *D*; *F*, a protecting shell or plating of metal, and *G* an exterior sheath or pipe of lead.

The central conductor, *A*, being hollow, may receive one or more small insulated conductors, or may be used for conveying liquids or gases, a novel feature in cable construction. The plating *F*, and leaden sheath *G*, may be utilized for a conductor, if desired.

The claims of the inventor, in substance, are as follows:

1. The method of forming a tubular conductor or pipe by arranging wires, strips, or the like around a core or center, and then depositing metal thereon by electrolysis, to unite the strands.

2. A tubular conductor or pipe having a base of wires, strips or the like, united by an electro deposit or plating.

3. The method of forming electrical conductors for cables by providing grooves or channels in insulating material, adapting the surface of said grooves or channels to receive an electro deposit, and depositing metal in said grooves or channels simultaneously.

4. In the manufacture of lead-encased conductors by a pipe-press, the method of protecting the insulating material by enveloping the same in a metallic shell or plating before passing through the pipe-press.

5. An electrical conductor having a metal shell or plating outside the insulating material, and a leaden sheath applied to said shell or plating.

6. An electrical conductor having a hollow tubular conductor at the center, and a series of conductors arranged about said hollow conductor at a suitable distance, and insulated.

7. An electric cable or compound conductor, comprising a central conductor, a tubular conductor surrounding the same, a series of conductors around said tubular conductor, a leaden sheath, and a protective metallic shell or plating inside said sheath, said conductors being separated from each other and from said shell or plate by insulating material.

8. A tubular conductor formed of insulated wires woven, braided, twisted, or similarly arranged, and united by electroplating.

Burying Telegraph Wires.

IMPRACTICABILITY OF CHANGING THE PRESENT SYSTEM TOO RAPIDLY.

The annual report of Capt. F. V. Greene, the engineer officer of the District of Columbia, just made public, contains an interesting discussion of the problem of placing telegraph and other wires under ground. Capt. Greene says: "It is to be noticed that in New York, Philadelphia, and Chicago, laws have been passed ordering the peremptory removal of all telegraph poles on a certain date. In all of these cities the dates have passed, and the laws have not been repealed, but the poles still stand on the streets. The interests involved are too great to permit the telegraph business of the country to be cut off in this summary manner. The placing of wires under ground in cities will require a large outlay of capital, and will consume a considerable amount of time. The work can only be done gradually. More progress has been made in Washington than in any other city in the country. The policy adopted by the commissioners, and consistently carried out for the last three or four years, has been to refuse permits for reconstructing pole lines within the central part of the city, and to permit extensions in the outer streets and in alleys, and on condition that a certain amount of underground work shall be done as an equivalent. The telephone company has been most in need of extension, and hence it has to-day the largest amount of underground wires. The electric light companies have been refused any permits except on the same terms, and they are still debating whether it will be profitable to accept them. No extensions of the electric light (except the underground line on F Street) have been made in the last three years. The older telegraph companies, having their pole lines already established, have not until now felt the necessity of asking for permits. But the rotting of poles and the growth of trees carrying moisture into their wires have compelled them to make a beginning, and the same causes would in a few years effect the removal of all the objectionable poles in the heart of the city, and thenceforth the placing of wires underground would keep pace with the growth of the city, provided the commissioners retain control of the matter and pursue the same policy they have been pursuing. If the higher courts confirm the decision already made—that the commissioners have no legal right to make such agreements as they made with the Western Union Company—then, of course, the matter will have to go to Congress for new legislation, in which it is to be hoped that the new commissioners will succeed in increasing the power they have already exercised to prevent the aggregate increase of pole lines, and to compel the gradual removal of the most objectionable ones."

The Local Telephone Service of Lowell, Mass., Seriously Interrupted by Fire.

The tower on the roof of Shattuck's block on Central street, Lowell, Mass., connected with the central telegraph office, and in which all the wires connected with the local system concentrate, was discovered to be on fire during a severe storm last week. A messenger was at once dispatched to the engine house on Middle street to give the alarm. The chief engineer and the hose trucks soon responded, and the Protective and Chemical arrived a few moments later. Both companies did good service, and with the addition of other streams the fire was soon under control, but not until the interior of the tower was burned to a coal, and the multiplicity of wires that enter it, melted, twisted and disarranged, reducing them all to a condition of utter uselessness for practical operation. The heavy fifty wire cables running to different parts of the city and beyond were melted into a homogeneous mass, and the individual wires were snarled up in hopeless confusion. The damage was confined to the tower itself, and fortunately did not work into the roof of the block up on which it is located. In the operating room below, the young lady operators, about a dozen in number, were seated at their respective tables, more or less anxious, as might be expected, at the electrical disturbance outside. When the shock came, which doubtless set fire to the tower, a loud report was heard in the room. The electric fluid entered the room by a single wire and burned out a coil at table G, at which Miss Effie Clark was seated. The alarm of fire was then heard, and the young ladies made a hasty exit from the building, assisted by the male employes. They were much frightened, of course, but they behaved with commendable coolness, and there was no panic or signs of one. Miss Sarah Carter, who occupied a rear room in the block, was sick in bed at the time of the alarm, and became so excited at the confusion that it became necessary to remove her, and she was carried across the street by the firemen, and taken back after the fire was extinguished.

As to the origin of the fire, it was first thought that it was caused by lightning, although the managers think there is chance for a reasonable theory to the contrary. The wire upon which the electric current entered the operating room, and presumably the tower above, was a short line running between the central office and the Baltimore and Ohio telegraph office.

The managers of the telephone company say there is a possibility that the current was created by contact with the electric light wire, as several lights were in operation at the time, and the high wind might have created the contact.

The question may be asked, Why didn't the "lightning arresters" take care of the destructive current, as they are expected to do? All the wires entering the tower have the lightning arresters on them, and they took care of all the current they were capable of; but there was too much electricity to pass through the ground-wire, and the surplus current must have diffused itself through the structure and set fire to the dry lumber of which it is composed. The fact that no damage was done in the operating room is good evidence that the arresters performed efficient service, and had they not been attached, the destruction of apparatus, and possibly of human life, must have been imminent. That the fire was confined to the tower above is good evidence that safeguards can be applied to keep this destructive intruder out of the operating room.

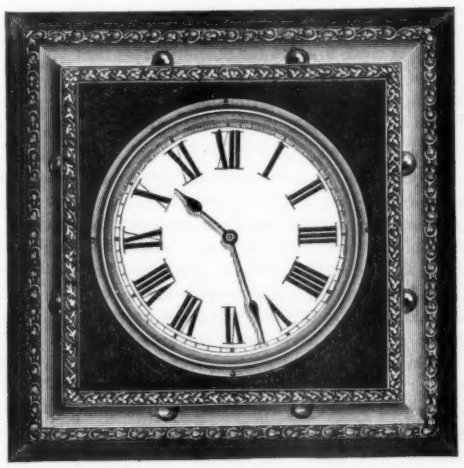
Although the pecuniary loss of the fire will be inconsiderable, the telephone-using public will have occasion to consider it one of the most important they have had for a long time. The managers say that with the utmost promptness and industry it will be impossible to have the system in running order again for three or four days, and possibly a week. The trunk lines passing out of the city will be repaired at once, and will doubtless be in working order to allow communications through the city from points outside, but no business can be transacted at the central office in this city until the wires are all tested and the connections made. This will be a serious loss to subscribers who consider the telephone as indispensable to their daily life, but there is no help for it, and perhaps they will learn how to appreciate the telephone when the difficulty is repaired, by having been deprived of it for a few days. The telephone company has no insurance.

FIG. 7.—ELECTRIC MANTEL CLOCK.

General Manager Keller, General Superintendent Wheeler, and I. H. Farnham, Acting Electrician, were early on the ground, and took prompt measures to get the exchange in working condition.

Native Copper.

Native copper for years has been brought down the Copper or Atna River of Alaska by the Indians, and from here found its way to many white people in the way of trade, and so on. The Copper River is not navigable, except in stretches, being full of rapids, falls, etc., by Indian reports at one place a glacier jutting into the stream. So far, the Indians have prevented the whites from entering this valley far, and have refused to disclose the whereabouts of the mine. The river is said by them to have two principal forks, and each one heads in a lake. Upon the Youkon River, specimens of copper ore were taken from the valley near the boundary, which at once indicated good azurite or the blue carbonate of copper. It came from quite an extensive ledge cropping out. All the rest that is known concerning it is from Indian reports, but agrees well with what would be expected. This blue stone, they say, crops out here and there for a distance inland equal to a day or two's journey in the winter with dogs and sledge, or probably from twenty to thirty miles; they then have the same appearance of a reddish stone for a like distance, and then they come to a lake in the mountains, where is found native copper in sheets, and where they get enough for arrow-heads, although they seldom visit it, owing to hostile Indians living about it. Geologically, their reports agree well with facts. In the mountainous country, where igneous action has been at work since the copper was deposited, it has been smelted by natural operations, and appears in sheets as native copper, while the azurite or blue carbonate is in its original form of deposition, while half way between, the heat, though not great enough to smelt, has driven away an equivalent of carbonic acid, leaving it as cuprite of red oxide. If the deposits are anything near like the dimensions given by the Indians, this copper field must rival any district now known of that mineral. The Yukon is navigable well past this district, and large quantities of Sitka spruce cover the country near it, from which coke could be made for smelting, while coal exists, though not tested, on the river a little lower down. Agriculturally, Alaska is poor, though hardy vegetables, by extra care, can be raised in some parts sufficient for local consumption, although, if other industries open lines of transportation, they too will be imported.



ELECTRIC TIME MINUTE DIAL.

ELECTRIC TIME MINUTE DIAL.

.... A new telegraph line has been established in New Hampshire between Wolfeborough and Alton Bay, *via* Dover.

.... On Wednesday last, at Leeds, England, Lillian Roberts, a student at Malton

ELECTRIC TIME MINUTE DIAL.

College, was remanded on a charge of forging a telegraphic message purporting to be from the Public Prosecutor at Leeds to the Imperial District Court of Justice at Bozen, Austria, authorizing the liberation of Max Doring, a photographer of Leeds, who had been apprehended on a charge of felony.

.... The *Times-Democrat*, of New Orleans, talks of establishing a pigeon post from Point Eads, about seventy miles air line. Years ago there was a pigeon line from the pilot boats to New Orleans, which repeatedly beat the electric telegraph, in consequence of its advantage in bringing dispatches from a distance at which arriving vessels could not be recognized by the observer for the telegraph company. Under the circumstances we are willing to admit that the pigeons might beat the telegraph, but not where electricity is given an even chance. A pigeon line would not have to contend with the messenger boy as final deliverer, it would be well to notice:

TELEGRAPHIC

.... There are 68,000 miles of submarine cables in use, and the man who gets his first cable despatch feels as if he owned the whole of them.

.... A telegraph line is about to be built between Moose Jaw and Woodhills, and another is being constructed between Edmonton and Peace Hills, by the military authorities of Canada.

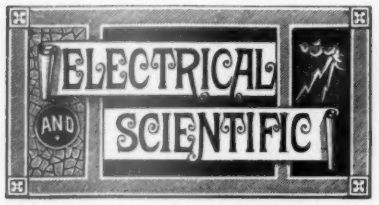
.... The young women employed in the South Australian post and telegraph offices presented Mr. Todd, the Postmaster-General, on the occasion of his departure for Europe, with a traveling bag and fittings.

.... The Mexican Central Railroad Company is erecting a new telegraphic line between Mexico City and Silao. Afterwards it will be continued to Paso del Norte, thereby increasing the easy and rapid transmission of telegraphic messages between the various points along the line of that road.

.... An official of the Baltimore and Ohio Telegraph Company, in speaking of their recent New York fire, says: "The first estimates of our loss were greatly over-stated. It will not exceed $10,000 or $15,000. Our loss was chiefly in furniture and instruments, about 200 of which were destroyed. The fire was undoubtedly caused by lighted firecrackers dropped through a grating on the Church Street front of the building."

.... The Baltimore & Ohio Telegraph Company, as stated in the REVIEW last week, has made an arrangement with the gentlemen controling the Averill underground telegraph conduit to make an experiment with the conduit in Washington. The agreement is that the owners of the patent shall lay a conduit to carry the lines from the main office of the telegraph company, corner Fourteenth Street and Pennsylvania Avenue, to the Baltimore & Ohio depot. After two years' use, if the company is satisfied with it, it will pay for the conduit, and also for the use of it during the two years of probation. Officials say that this is a mere experiment, and the company is not committed to the use of the conduit unless it proves entirely satisfactory.

All companies are looking for a good underground system — one which will combine the elements of durability, cheapness, and perfect insulation. The owners of the Averill conduit make claim to having accomplished what is wanted. The experimental conduit will begin at the corner of Fourteenth Street and Ohio Avenue, where the Baltimore & Ohio wires are now taken up by poles from the short conduit carrying the wires from the main office to the point named, and be laid by a route yet to be determined to the Baltimore & Ohio depot. It is proposed to carry 75 wires in this conduit. The company will not abandon its poles unless this system proves satisfactory. The conduit will be laid in a trench. It will consist, briefly speaking, of layers of fine asphalt, sand and silicate, between which the wires will be imbedded. Upon boards at the bottom of the trench will be rolled the first layer of asphalt. Over this will be passed a reel stretching along over the soft asphalt, as it goes, as many naked copper wires as the service may require or the width of the trench will permit. Upon this layer of wires another layer of asphalt will be rolled, imbedding the wires in the material so that they will be completely protected, and, it is claimed, the difficulties arising from induction will be reduced to the minimum. The wires will be numbered, and in case any necessity arises for repairing or tapping a wire at any point, it can be reached by use of a cold chisel or tools made for the purpose. The work of laying the conduit will, it is said, be begun in a few days.



* * The report is denied that the Harrison Wire Company, of St. Louis, Mo., intends to remove its works to Pittsburgh, Pa.

* * The pyrometer, an instrument in which heat is measured by the expansion of metal, will accurately measure heat up to 7,000 degrees.

* * Parties interested in the recently organized Braddock Wire Works will soon start a mill on the Baltimore & Ohio Railroad near Homestead, Pa., for the manufacture of steel rods.

* * The Spang Steel and Iron Company, of Pittsburgh, Pa., completed on the 26th ult. the steel plate girders for the Bartholdi statue. The order was for 50 tons of steel plates, weighing from 1,000 to 2,000 pounds, and work was only begun on the 24th ult.

* * An electric engine has been patented by Mr. William A. J. Kohrn, of San Francisco, Cal. Combined with field magnets, swinging armatures with coils, and a battery connected with the field magnets, another battery is connected with the coils of the armature, and there are devices for automatically closing and opening the circuits of the field magnets and of the armatures, with other novel features.

* * Dr. M. E. Wadsworth finds that the assumption that the earth has a "a heterogeneous viscid, elastic, liquid interior, irregularly interlocked with and gradually passing into a lighter heterogeneous crust," accords better with geological facts than any other of the various hypotheses thus far advanced. Contraction and upheavals of the crust resembling in their effects what is sometimes seen in ice, would satisfactorily explain volcanic and earthquake phenomena.

* * The Boston & Albany railroad signal service men are testing on its electric signals the new Leighton galvanic battery. The inventors claim that it saves at least 10 per cent. on labor and material over all other gravity batteries now in use. The battery gives a very steady current, and will not decrease while there is crystal left. It is claimed that it can be run from six months to a year by feeding blue vitriol, without taking the jars from the shelves or changing the sulphate of zinc solution.

* * Travelers in polar regions have survived exposure to a cold as great as 75 degrees below zero, Fahrenheit. On the other hand, the inhabitants of some parts of the globe are forced to endure at certain periods a natural temperature considerably higher than 100 degrees above zero. A still greater heat—greater even than 200 degrees—may be borne by the human body for a short time. Brewster mentions that Chantry and five or six friends remained two minutes in the sculptor's drying furnace, bringing out a thermometer which stood at 320 degrees. Chantry's workmen entered the furnace when the temperature was as high as 240 degrees.

* * M. Morize, of Rio de Janeiro, has invented an ingenious solenium apparatus for measuring the relative intensities of the rays of the sun at different altitudes above the horizon. It consists of a selenium cylinder prepared according to the plan of Professor Graham Bell, 38 discs of copper being insulated from each other by smaller mica discs, and the edges filled in with selenium. It is insulated by glass supports inside a glass envelope, from which the air has been exhausted. The vessel is elevated in a place where surface reflection does not reach it, and the axis is placed parallel to the axis of the earth, so that the rays of the sun fall normally on the selenium cell, and illuminate the same surface. Its position can be altered to keep up this condition from day to day. A constant current traverses the selenium and a galvanometer in circuit with it.

* * The erection is announced in Berlin of a large manufactory of electrical apparatus. The necessary funds have been furnished by a group of capitalists in Berlin and Hamburg.

* * Professor Trombolt, in Norway, has met with partial success in photographing the aurora borealis—a feat which his many failures had led him to pronounce impossible. After exposing a plate for eight and a half minutes, he secured a negative of an aurora, but the impression is so very faint that it cannot be reproduced as a positive.

* * Barometric changes are determined in south Chili by the use of the cast off shell of the crab, which is said to be extremely sensitive to heat and moisture. It will remain quite white in clear, dry weather, but will indicate the approach of moist atmosphere by the appearance of small red spots, which grow in number and size as the moisture increases, and on the appearance of rain the shell becomes entirely red, and remains so while the moisture continues.

* * It is stated that a torpedo, designated the "Octopus," has been invented by a young non-commissioned officer belonging to the Royal Engineers, at Chatham, England, who will shortly place the plans in the hands of the Secretary of State for War. The charges are fired by electricity, and it is stated that the torpedo is adapted for the defence of mouths of harbors, rivers, etc., without endangering friendly navigation, and obviating the necessity of recording their position.

* * Dr. Lamson will not have died in vain if the suggestion made by one of the British authorities on insanity is hereafter applied to test the perceptive faculties of alleged insane murderers. The suggestion is that a red-hot poker be handed to the said alleged insane person; if he takes it, he is to be adjudged as really unable to distinguish between right and wrong; but if he refuses it, then he is to be considered responsible and be made to suffer accordingly. The test is a very simple one, and there should be no reason why it should not be accepted as satisfactory. He who can remember that a red-hot poker burns can also remember that to kill another is a crime.

* * The oldest paper in the world, the Pekin *Gazette*, has lately taken a new lease of life. The venerable journal, alone almost in a changeless land, has changed its form. Established in the year 911, the Pekin *Gazette* has been published regularly since 1351. Under the new arrangement three editions are published: the first, the *King-Paou*, printed upon yellow paper, constitutes the official gazette of the Middle Kingdom; the second, the *Hsing-Paou* (commercial journal), also printed upon yellow sheets contains information interesting to the trading community; while the third, the *Titani-Paou* (provincial gazette), printed upon red paper, consists of extracts from the other two editions. The total circulation of the three is 15,000 copies. The editorship is confided to a committee of six members of the Academy of Han Lin.

* * The employment of natural gas as a fuel by manufacturing concerns may mean more to our industrial interests than has been generally anticipated, says the *Railway Review*. Great sums of money have been invested in changed plant by many heavy houses, who figure upon material profits through the use of the novel fuel. Despite the dangers which the timid ascribe to its use, and the lack of absolute certainty as to permanence of supply, the heavy capitalists of Pittsburgh have enough faith to warrant these large expenditures. Some of the anticipated results in the way of savings have already made themselves felt. For instance, it is estimated by good judges that there are already 3,000 tons less of coal burned in Pittsburgh per day than there were before natural gas was used. This takes away a coal business of $2,500,000 or more a year. One concern saves $100 a day in wages formerly paid men who wheeled out ashes. The decrease of smoke in the atmosphere is already noticeable.

* * An electrician asserts that in bodies in which life is not extinct the temperature rises upon the application of an electric current, but never in the case of actual death. This fact supplies a test for use in cases where life is suspected to remain in persons apparently dead.

* * A South Carolina genius claims to have invented a perfect system of car coupling by electricity. Upon a recent trial a freight train was cut in four pieces and again coupled up without the aid of any person except the conductor, who did the entire work from the rear car.

* * A Vienna telegram says a terrible explosion has just occurred in Hungary, in which the inventor of a new sort of dynamite has fallen a victim to his own invention The man was engaged in nailing up a box containing a consignment of the material, when suddenly the whole blew up, unroofing the house and burying the inventor and his mother under the falling ruins.

* * The New York, Susquehanna and Western Railroad Company are having a new electric signal placed on the trains of their road in place of the old-fashioned bell rope. The batteries which supply the electricity are in the cab of the engine, near a large bell. Fine wire is stretched through the cars and connections are made midway between the cars by bringing the ends together in a small clasp. The exposed portions of the wires are covered with rubber. By the side of the door at each end of the car is placed a button similar to those used on all electric signal wires. By pressing on a button the bell in the cab is rung.

* * W. B. Valentine, of Painesville, Ohio, is the inventor of a unicycle which promises, when fully perfected, to astonish the world by its utility and the speed of which it will be capable. The vehicle consists of a wheel 12 feet, 10 inches in diameter, which gives a circumference of 40 feet. The center of the wheel is pierced by a shaft, into which the spokes extend from the tire at a considerable angle. Suspended from the center of the shaft in the space between the spokes is the seat to be occupied by the operator. In propelling the wheel the operator works a treadle that is so adjusted as to utilize his full weight in ascending hills or traversing heavy roads. On each end of the shaft hangs an iron rod that extends to within a few inches of the ground. By an ingenious contrivance the lower end of these rods—which are denominated "safety-rods"—can be shifted at the pleasure of the operator to positions near to or some distance from the tire of the wheel. The regulation speed will, however, be two revolutions per second, which is easily attained, and will represent a rate of almost a mile a minute.

* * Messrs. Poole & Hunt, engineers and machinists, have constructed at their shops in Woodberry some powerful machinery for the Chicago cable street railways. The cable roads are a success in that city, and the company is adding a thousand more horse-power, and extending the lines seven miles further. Poole & Hunt have shipped three great wheels for the operating apparatus, one of them weighing 90,000 pounds. Another great gear-wheel, in one piece, with double arms, weighed 27,000 pounds, and was the largest ever made in this country. The mate to it weighed 17,000 pounds. The firm have furnished a good deal of other work for the operating apparatus which they contracted to supply. They furnished the operating apparatus for the Kansas City cable road, which is now running, and for the Hoboken and New York Tenth Avenue roads, which are completed, but not yet in operation. Mr. Germon H. Hunt says the first cost of cable roads is large, but when properly built they are a success, and more of them will come into use soon. The cable road experiment in Philadelphia was less satisfactory than in Chicago because of faulty construction. The winters are more severe in Chicago, and frost damage can there be at its maximum. Yet the Chicago company has met with success, and is spending large additional capital to increase the cable road service.

Underground Wires.

During the last few years the number of electric wires in all of our large cities has rapidly increased, especially since the introduction of the telephone and the electric light; and the probability is that the next few years will show a further large increase. If these wires run on poles, they not only disfigure the streets, but seriously interfere with the operations of firemen, as we have repeatedly seen during the last few years. A cobweb of wires supported on housetops requires the line men to continually tramp through the houses and over the roofs, causing annoyance to the tenants, and damage to the buildings. Moreover, wires fixed to housetops are subject to removal at the whim of the owner, and they have to be continually removed from building to building as the good will of each owner is exhausted. Again: overhead wires, whether placed on poles or housetops, are continually coming in contact with each other, causing annoyance and danger; and an extra heavy rain or sleet storm so entangles and breaks them as to entirely interrupt communication The annual cost of repairs of overhead wires in cities is not less than thirty per cent. of the first cost of construction.

In almost all of the large cities the question is being asked, Why cannot these wires be gathered into cables and buried, along with the gas and water pipes, under the streets? In answer, it is proposed to review briefly the technical difficulties that arise, and to show how they may be and are overcome. It is proposed, further, to compare the cost of construction and maintenance of overhead wires with the cost of construction and maintenance of underground cables, and thus to see which is desirable from economical consideration.

There are two reasons, apart from the difficulty of securing good insulation, why underground lines are comparatively inefficient:

1. If an electric conductor be brought near to a large mass of conducting-matter, as is a wire when it is taken down from a pole and buried in the earth, there appears in the current the phenomenon of retardation, by which each signal, instead of being sharp and distinct, is partly kept back, so that it overlaps and mingles with the next. The result is to limit the speed of working of the apparatus, or, if, like the telephone, it be an apparatus in which the currents are necessarily extremely frequent, to confuse and destroy the signals altogether.

2. The second difficulty is called induction, and is noticed when two or more wires are run side by side and near together, as they necessarily are in an underground cable. If the signals on one wire of such a cable be sharp and quick, they cause *facsimile* signals on all of the neighboring wires; and this, too, though the insulation may be absolutely perfect. The result of this phenomenon is, that messages sent over one wire are liable to be received on all of the other wires; and in telephony each person can easily overhear all that the others are saying.

Fortunately, however, both of these difficulties vary with the electrical qualities of the cable; and while I have seen cables of a thousand feet, over which it was difficult to talk, and in which the cross-talk was nearly as loud as the direct conversation, on the other hand, I have conversed easily over an underground cable extending from Paris to Orleans, eighty-five miles; and this, too, while other parties similarly separated were talking over other conductors of the same cable. There was absolute secrecy.

Last summer I visited France and Germany, and made, together with Mr. Berthon (chief engineer of the French telephone company), Mr. Cael (chief engineer of the French government telegraph), and Herr Guillaume (constructor of the underground lines of the German empire), a series of telephone experiments on underground lines, varying from 5 to 100 miles in length, from 2.87 to 48 ohms resistance, and from 0.06 to 0.35 microfarads capacity per mile.

These experiments furnish us with ample data from which to deduce the requisites of

any cable, in order that it may transmit speech, and without cross-talk from the neighboring conductors. These are briefly as follows:

1. Good conductivity.

2. High insulation; for without this the current leaks from one conductor to the others, giving rise to cross-talk; and it is possible to talk by direct leakage between two conductors whose insulation is several million ohms.

3. Low specific inductive capacity; for, the greater the capacity, the greater the retardation, and the greater also the cross-talk due to induction.

Below is a table showing the specific inductive capacity and insulation of various insulators. The measurements were all made on a wire 0.05 of an inch in diameter, coated with insulation to a thickness of 0.10 of an inch.

Cable.	Maker.	Insulation per mile in megohms.	Specific inductive capacity in microfarads.
Gutta-percha	Siemens Bros., London.....	190	4.2
India rubber.	Rattier, Paris..	170	3.7
Renti.....	A. G. Day, New York,.....	150	4.0
Faraday.....	Faraday Cable Works, Cambridge, Mass.	15,000	1.6
Patterson....	Western Electric Co., Chicago.....	450	3.1
Brooks.....	David Brooks, Philadelphia.	.....	2.8

Let us take a special case, and compare a gutta-percha cable having a specific inductive capacity of 4.2 with a Faraday cable of 1.6. The table predicts that we can talk three times as far with the latter as with the former, and experiment shows that we can. Again: the cross-talk on the gutta-percha cables ought to greatly exceed that on a Faraday cable; and experiment has shown, that, while conversation over a two-mile gutta-percha cable was continually disturbed by existing cross-talk, conversation was carried on over a similarly constructed Faraday cable five miles in length without the cross-talk being appreciable.

By proper attention to the electrical qualities, then, we may talk underground a much greater distance than we shall ever have reason to in any city system, and this without cross-talk from the neighboring circuits.

We have seen that telegraph and electric lighting currents are not subject to the technical difficulties we have been discussing, and that, provided good conductivity and good insulation are assured, it is with them purely a question of expense. Let us, then, determine the relative expense of overhead and underground wires.

Suppose we have a large city with a telegraph office near the center, and that it is desired to carry a hundred wires to the city limits, say, three miles distant. Let us suppose that the wires for the first mile rest on housetops, and for the remainder of the distance on poles. The cost will be:

35 roof fixtures .....@	$45	$1,575
80 poles, with arms, etc.....@	65	5,200
300 miles No. 9 wire.....@	16	4,800
Stringing 300 miles wire.....@	8	2,400
		$13,975

Underground the cost would be:

6 miles (50 conductors) No. 17 lead-covered cable.....@	$3,000	$18,000
3 miles trenching, troughing, laying, and re-filling.....@	2,000	6,000
		$24,000

That is, the relative first cost of an overhead and an underground line, to do the same work, would be, say, $14.000 and $24,000.

The same conclusion will hold true for telephone wires, provided we confine ourselves to the problem of running out from the central office, by fifty or a hundred conductor cables, to a large number of distributing points, so situated about the city that any subscriber would be easy of access, by a short overhead line, to one or another of them; and this is the problem that really occurs. So much for construction.

The yearly cost of repairing an overhead system, including roof rentals, is not less than thirty per cent. of the cost of construction; and the line would have to be renewed once in twelve years. The cost of repairing an underground system is practically *nil*. The Paris telephone company, with wires extending to three thousand subscribers, does not keep any repair men. The durability of an underground system, provided lead-covered cables are used, and there is no internal cause of deterioration, is at least thirty years. Last summer we examined some lead-incased gutta-percha cables that had been in use by the French Government for that length of time, and found them in perfectly good condition. The same is true of India-rubber cables incased in lead.—W. W. JACQUES, Electrician of the American Bell Telephone Company, *in Science*.

On the Measurement of Currents.

BY M. E. HOSPITALIER.

The industrial apparatus for measurement give concordant results only with continuous currents, such as those furnished by batteries and accumulator. When the current takes a decidedly undulatory form, as, for instance, the current furnished by an Anatole Gerard's machine, in which it becomes periodically zero four times in each revolution, still remaining in the same direction the indications furnished by amperemeters and voltmeters are always lower than those which would correspond to the true value of the electric energy consumed in the exterior circuit.

We have determined experimentally, with the aid of the pupils of the School of Industrial Physics and Chemistry of the City of Paris, and thanks to the kindness of M. A. Gerard, who has placed one of his machines at our disposal, the absolute value of the discrepancies between the measurements on supplying glow-lamps successively with continuous currents or otherwise.

The following are the results of our experiments:

When the lamps are brought up to the same luminous condition, the indications of an electro-dynamometer introduced into the circuit remain the same, whether we make use of a continuous current or not.

The indications of a Deprez-Carpentier amperemeter are on an average 10 per cent. lower with adjusted currents than with continuous currents. The indications of a Thomson or a Deprez-Carpentier voltmeter applied at the extremities of the machine, are about 15 per cent. lower with adjusted currents than with continuous currents.

We see thus that the form of the currents introduces differences which can by no means be neglected, since they cause us to attribute to one and the same lamp a consumption in voltamperes or in watts, too small by 23.5 per cent. when it is supplied by adjusted currents.

The cause of the difference is that the indications of the amperemeter are proportional to the mean intensity introduced into the formula

$$W = R\,I^2$$

in order to calculate the mean work per second is always smaller than the mean of the squares of the intensity as inferred from the indications of the electro-dynamometer, which represents the real expenditure of the lamp.

It is the same with the voltmeter, which gives the mean difference of potential at the terminals of the lamp, but the discrepancy of the results obtained with adjusted currents and with continuous currents is still increased by the self-induction of the voltmeter, which tends to enfeeble the mean current traversing it and to diminish its indications.

It results from our experiments, that in calculating the consumption of glow-lamps supplied by adjusted currents, gross errors are committed if we take the product of the volts and the amperes indicated by magnetic apparatus for measurement, standardized with continuous currents.

This consumption can only be calculated exactly with adjusted currents, by measuring the intensity with an electro-dynamometer and the difference of the potentials by means of the quadrant electrometer (idiostatic method), or of Cardew's voltmeter.

Western Union Acquires the American Rapid.

Judge Donohue, of the Supreme Court, made an order last Friday in the suits of the Farmers' Loan and Trust Company and others against the Bankers and Merchants' Telegraph Company, directing the receivers of that telegraph company, and of the American Rapid Telegraph Company, the lines of which form a part of the Bankers and Merchants' system, to turn the lines of the American Rapid over to the Western Union Telegraph Company.

The order was based upon a contract between the Western Union and the receiver of the American Rapid. Under this contract the Western Union will control and operate the lines mentioned, but gives no guarantee. The contract under which it acquires the American Rapid is said to be similar to the contract recently made between the Mutual Union on behalf of the Western Union and the Southern Telegraph Company, which was also a part of the Bankers and Merchants' system. The only line of importance which the last-named company now has is that between this city and Washington.

A dozen linemen appeared on the roof of the Bankers and Merchants' Building about 4 40 o'clock in the afternoon, and in twenty minutes they had removed every wire and cable belonging to the American Rapid Company. By 5 o'clock all these wires had been carried into the Western Union office, and all the switch connections had been made.

—— The Consolidated Electric Light Company, Portland, have decided to increase their power by adding more Armington & Sims high-speed engines.

—— The E. Mather Electric Company have opened a branch office at 99 and 101 West Second Street, Cincinnati, Ohio. W. A. Gray is in charge, and will look after their electric lighting business in the States of Ohio, Kentucky and West Virginia.

—— The citizens of Minneapolis, Minn., are continually petitioning the Council for more electric lights. It seems to be one of the natural results of the introduction of this light that everybody is desirous of more light, and this is, no doubt, the reason why the electric light has brought with it an increased consumption of gas in a great many places.

—— "What a wonderful thing the electric light it!" "Yes, it is wonderful. I expect after a while it will be used to make the crops grow, instead of the sun." "There are some crops now that thrive by electric light." "Nonsense." "No nonsense about it. There are lots of young men who sow most of their wild oats by the electric light."

—— A dynamo electric machine has been patented by Mr. Jose M. Rivera, of Buga, U. S. of Colombia. The object of this invention is to so construct machines that the armature can be rotated without the use of belts or gear wheels, and a greater or less number of machines can be coupled on one shaft; also to facilitate the winding of the armature and improve its general construction.

—— An advocate of gas complained that the electric light was so poor in his city that he had been requested by young ladies to be their escort through the dark streets. The electric light man rejoined with the statement that the champion of gas was so handsome and fascinating that the reason the ladies desired his company was on the score of gallantry, and not of poor light. As there was no satisfactory answer to this, the discussion ceased with electricity ahead.

—— The largest room in the world under one roof, and unbroken by pillars, is in St. Petersburg. It is 620 feet long by 150 feet in breadth. By daylight it is used for military displays, and a battalion can completely manœuvre in it. Twenty thousand wax candles are required to light it. The roof of this structure is a single arch of iron, and it exhibits remarkable engineering skill in the architect. The electric light should take the place of wax candles in this place. Here's an opportunity for an enterprising company.

ELECTRIC LIGHT NEWS

—— Easton, Pa., is arranging to light its streets with electricity.

—— Philadelphia, a city that owns its gas-works, is now ready to sell them, having come to the conclusion that it is too difficult for a city to carry on a manufacturing business economically.

—— The Duchess of Westminister gave a dance at Grosvenor House, London, on Thursday night, when the Rubens Room and Picture Gallery were illuminated by the electric light for the first time.

—— With the exception of the Jablochkoff candle, electric arc lights are all substantially the same in form and method of working, but a new departure has been taken by an inventor named Varley. His carbons, instead of being sticks, are flexible, and are wound upon two bobbins, from which they are unrolled as they are consumed.

—— Messrs. R. E. Crompton & Co., of the Arc Electric Light Works, Chelmsford, England, have completed a projector for an ironclad in the Brazilian navy, to be used for torpedo warfare. The lamp is of 25,000 candle-power, and with its assistance any object on the sea within a radius of three miles can be detected with great ease.

—— The Brush Electric Company makes the following announcement: "We commenced suit this week in Indianapolis against user of Jenny apparatus, sold by Fort Wayne Company, and other suits will follow. We now have more than a dozen suits in progress in various cities against infringers of Brush patents, and we propose to show no mercy. The Jenny apparatus is a clear infringement, and suits against them will be pushed vigorously."

—— Edward W. Colton, an electric light cleaner, was cleaning the light at the corner of Maverick and Havre Streets, Boston, Monday evening, when the current was turned on and he received the full shock. When the current struck him he was stunned, and, losing his balance, fell across the bar at the top of the light stand. His wrist, coming in connection with the wire, was very severely burned. He received no permanent injury. If he had taken proper precautions, the accident would not have happened.

—— The *Plain Dealer*, of Cleveland, is against the lighting of city streets by electricity, on account of the expense. Here in New York, while electric light doubtless costs more than gas, we don't believe that it will be abandoned for that reason. In important avenues and large public squares the brilliant illumination of electricity adds to the public safety as well as to the public convenience, and we are confident that it will be maintained. Besides, some man may come along presently whose inventions may reduce the cost. Electric lighting is probably a permanent institution for all large American towns.—*N. Y. Sun.*

—— The process of erecting the tower for the West Indianapolis electric light is attracting the attention of the "Hoosiers." It is not built "from the ground up," by any means. On the contrary, it is built from the clouds down. A section, surmounted by a hexagonal cage containing the six lights of 2,000 candle-power each, measuring full forty-five feet in height, including the cage, was hoisted by stout derricks about twenty feet into the air, and under it a section of twelve or fifteen feet was set and bolted firmly. The whole mass was then to be hoisted high enough for a second section to be set in and bolted below, when another hoist would make room for a third section, and so section by section the upper part will be hoisted up and the lower attached and securely bolted and braced till the whole 125 or 130 feet will be completed. It is a new process, that of building from the top down, but it seems to work well in this case.

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